



INSTALLATION, OPERATION, AND MAINTENANCE MANUAL



ANSI Process Pump



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Guarantees of performance and warranties are based on the use of the original equipment manufactured (OEM) replacement parts. Griswold Pump Company assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated.

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INTRODUCTION

Foreword

This manual is intended to assist those who are involved with the installation, operation and maintenance of the Griswold Model 811 ANSI B73.1 Process Pump. These instructions should be reviewed in their entirety and should be thoroughly understood prior to installation, operation or maintenance on the pumping unit. If there are any questions, contact either Griswold Pump Company or your local authorized Griswold representative prior to proceeding.



Failure to read and comply with installation, operation and maintenance instructions will void the responsibility of the manufacturer and may result in bodily injury or equipment damage.

This manual should be kept as a part of the permanent records for the pump and should be readily accessible as a reference to anyone working on the pumping unit. Referenced items numbers can be found on the cross sectional drawings that are located in Appendix VIII.

DEFINITIONS

These pumps have been designed for safe and reliable operation when properly used and maintained in accordance with instructions contained in this manual. A pump is a pressure-containing device with rotating parts that can be hazardous. Operators and maintenance personnel must realize this and follow safety measures. Griswold Pump Company shall not be liable for physical injury, damage or delays caused by a failure to observe the instructions in this manual.

Throughout this manual the words **WARNING**, **CAUTION**, and **NOTE** are used to indicate procedures or situations, which require special operator attention.



Operating procedure, practice, etc, which if not correctly followed, could result in personal injury or loss of life.



Operating procedure, practice, etc, which if not followed could result in damage or destruction of equipment.

Note:

Operating procedure, condition, etc, which is essential to observe.



Serious injury or damage to the equipment could result unless care is taken to properly lift and support equipment.

Receiving the Pump

Care should be taken when unloading and handling the pump, especially with regards to rigging and lifting. Suggested methods are:



FIGURE 1
PUMP ONLY



FIGURE 2
PUMP WITH BASE ONLY



FIGURE 3
PUMP WITH BASE & MOTOR

Never use eyebolts for lifting the pump. Eyebolts are used **only** to assist in lifting the back pull-out assembly component of the pump during maintenance.

Upon receipt, a thorough inspection should be made of the pump and related equipment. If materials are not received in good condition or there are shortages, make a notation of the damage and/or shortage on both the receipt and the freight bill. **Submit any claims to the transportation company promptly!** A documentation package is included with the pump shipment. Do **not** discard these materials. Put them in a safe place for easy reference.

Storage

If pumps are to be stored prior to installation, they should be kept in a clean, dry environment. Depending upon the duration of the storage, it may be necessary to apply preservatives and to perform routine maintenance such as regularly rotating shafts to prevent flat spots from forming on the bearings in both the pump and driver. If pumps are to be stored for more than 4-6 months prior to installation and/or start-up, follow recommendations listed below.

Storage for more than 4-6 months will require pumps to be prepared for long-term storage. Preservative treatment should be added to the power frame to aid against condensation and rust. Treatment shall be similar to Royal Purple VP Preservative Oil #10. All machine surfaces that are not painted or not of corrosion resistant material shall be coated with a light coat of machine oil or grease. The pump and motor shaft should be turned several rotations every 3 months or less and left 90 degrees from the original position. Store in a dry protected location insuring that flange covers are left in place and all openings are plugged.

Similarly, if the pump is to be installed and then started at a later date, it may be advisable to protect the pump during the idle time, especially if it's to be exposed to the elements.

Safety



If procedures outlined in this manual are not followed, personal injuries may result.

Griswold pumps have been designed and manufactured for safe and reliable operation when properly applied, operated and maintained in accordance with this instructional manual. Your safety is a primary concern for Griswold Pump, so we offer the following recommendations:

General Safety Precautions	
Never apply heat to remove an impeller. Trapped liquid, when heated, may cause an explosion.	Always wear personal protective gear – safety glasses, steel-toed shoes, gloves, etc., when working on the pump.
Never use heat during the dis-assembly of the pump. Trapped liquid, when heated, may cause an explosion.	Always lock out the driver before performing maintenance on the pump.
Never operate the pump without the coupling guard in place.	Never operate the pump with safety devices disengaged.
Never operate the pump beyond the service conditions for which it was sold.	Always follow established decontamination procedures before working on the pump.
Always start the pump only with proper prime.	Never operate the pump with a fully-closed discharge valve. If the pump is operated with no flow, its temperature will increase and damage may result.
Never run the pump dry.	
Never operate the pump without the suction valve fully open.	

INSTALLATION

Installation

The pump location should be clean, well ventilated, properly drained and allow room for maintenance and inspection.

Trouble-free operation of a pump begins with proper installation with particular attention being paid to the baseplate and piping attachments. A secure baseplate will enable accurate alignment to be attained and maintained. Flange loads from misaligned or improperly supported piping will make alignment difficult and will cause premature failures.

Baseplates and Anchors

The preferred mounting for a baseplate is on a concrete pad with grouting. No matter how robust its design, there is always some flexibility in the baseplate itself. If there is insufficient support under the baseplate, it can distort causing alignment difficulties and normal vibrations can be amplified to unacceptable levels through resonances in the pump support and/or piping. A properly grouted baseplate will resist distortion and will provide sufficient mass to dampen any vibration.

Note:

When pumps and motors are assembled on a baseplate at the factory, a preliminary alignment is done to ensure that the pump and motor can be aligned at its installation. This alignment is not to be considered as a final alignment. The factory alignment can, and does, change during shipment and when the pumping unit is installed. Actually, several alignments are necessary as will be described later.

Anchor (foundation) bolts are used to hold the baseplate to its support structure, whatever that may be. In the preferred case of mounting the pump unit on a concrete pad, the anchor bolts are set into the pad as indicated in the following illustration. When pouring the pad, it's helpful to have a wooden template attached to the foundation form to position the anchor bolts at their locations as indicated on the pump unit assembly drawing.

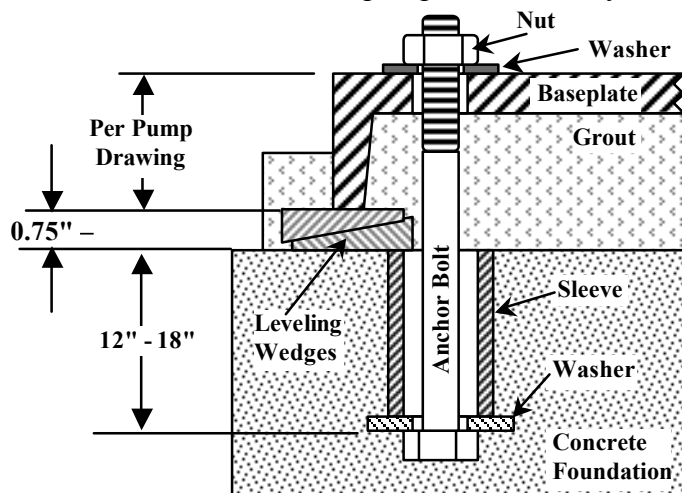


Figure 4
Typical Anchor Bolt (Sleeve Type)

Anchor bolts are usually sized $\frac{1}{4}$ " smaller than the anchor bolt hole size in the base. Calculate bolt length as indicated in Figure 4 at the left.

The ID of the sleeve should be two bolt sizes larger than the anchor bolt.

Allow approx. $\frac{3}{4}$ " - $1\frac{1}{2}$ " space between the bottom edge of the baseplate and the foundation for grouting.

A "Sleeve" type anchor bolt is shown here. Alternatively, a "hook" or "J" type anchor bolt may be used.

Pack the space between the anchor bolt and sleeve to prevent concrete and/or grout from entering this area.

Installing and Grouting Base

Note:

Before the baseplate is installed, it is advisable to thoroughly clean the underside to enable the grouting to adhere to it. Do not use oil-based cleaners since grout will not bond to it.

Once the concrete pad has cured, the baseplate can be carefully lowered over the anchor bolts. Place shims or tapered wedges under the baseplate at each of the anchor bolt positions to provide about 0.75" – 1.50" clearance between the base and the foundation. Adjust shims/wedges to level the baseplate. **Since there may be some flexibility in the baseplate, we must perform an initial alignment prior to grouting to ensure that a final alignment can be achieved. See section covering Alignment of Pump/Driver Shafts.** Potential problems here include bowing and/or twisting of the baseplate. If gross misalignment is observed, shims/wedges may have to be added under the mid-point of the base or the shims/wedges at the corners may have to be adjusted to eliminate any twist. If the driver feet are bolt-bound for horizontal alignment, it may be necessary to loosen the pump hold-down bolts and shift the pump and driver to attain horizontal alignment. When alignment has been achieved, lightly tighten the anchor bolts. The anchor bolts should not be fully tightened until the grout has set.

Grouting furnishes support for the pump unit baseplate providing rigidity, helping to dampen any vibration and serves to distribute the weight of the pump unit over the foundation. To be effective, grouting must completely fill all voids under the baseplate. For proper adhesion or bonding, all areas of the baseplate that will be in contact with the grout should be thoroughly cleaned. See note above. The grout must be non-shrinking. Follow the directions of the grout manufacturer for mixing. Proceed with grouting as follows:

Note:

If the size of the equipment or the layout of the installation require it, grouting can be done in two steps as long as the first step is allowed to cure completely before the second step is applied

1. Build a sturdy form on the foundation around the baseplate to contain the grout.
2. Soak the top of the concrete foundation pad thoroughly. Remove surface water before pouring.
3. Pour the grout through the hole(s) in the top and/or through the open ends of the channel steel baseplate, eliminating air bubbles by tapping, using a vibrator or pumping the grout into place. If necessary, drill vent holes into the top of the base to evacuate air.
4. Allow grout to set completely, usually a minimum of 48 hours.
5. Tighten foundation anchor bolts.
6. Re-check alignment to ensure that there have been no changes.
7. After the grout has dried thoroughly, apply an oil base paint to shield the grout from air and moisture.

You may then proceed to connect suction and discharge piping

Suction and Discharge Piping

A complete instruction for piping design is beyond the scope of this manual. A comprehensive guideline is available in the Hydraulic Institute Standards from The Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054, www.pumps.org. Note the following highlights:

In general, all piping must be supported independently of, and line up naturally with, the pump flanges. Even a small amount of pipe strain, or flange loading, will cause misalignment of the pump and motor shafts and cause vibration and premature wear. In cases of pumping at elevated temperatures, pipe expansion must be accommodated with expansion loops or expansion joints. These must be properly anchored to prevent pipe strain from being imposed on the pump from both thermal expansion and hydraulic reactive loads.

With the initial installation of the pump system, all piping must be thoroughly cleaned and/or flushed prior to pump start-up. Weld slag, rags, dirt and other debris can and will cause damage to the pump.

Piping design should incorporate the ability to flush prior to the removal of pump components in services where corrosive or otherwise harmful liquids are handled.

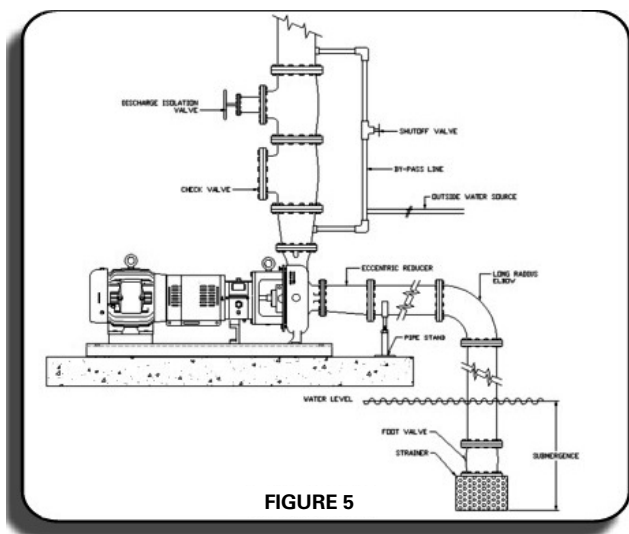
It is important to monitor the performance of a pump. So, in this regard, it's recommended that gauges be installed in the suction and discharge lines. Select the appropriate gauge range to provide accurate readings. On pumps with suction lift, use a compound or vacuum gauge on the suction side.

Suction Piping - General

Properly designed and installed suction piping is critical to the successful operation of a pump. When pump operational problems are encountered, the causes are most often on the suction side. To achieve proper pump performance, consider the following:

1. Avoid using elbows close to the pump suction flange as this can create an uneven flow into the pump suction and impeller. If an elbow is necessary, it should be of the long radius type and there should be a minimum of six pipe diameters of straight pipe between the elbow and the pump suction nozzle.
2. The suction pipe should be at least one size larger than the pump suction size. This will require an eccentric reducer to transition from the suction pipe to the pump suction flange. The flat side of the eccentric reducer is at the top. This is to prevent air pockets in the suction line.
3. If a strainer is used on the pump suction side, it must have a free area at least three (3) times the area of the suction pipe. It must be checked and cleaned regularly as a clogged strainer will reduce NPSH available and may cause cavitation.
4. **Never** throttle the suction side of the pump. This can cause cavitation and will likely damage the pump.
5. When the suction supply source feeds more than one pump, separate suction lines are recommended.

Suction Piping – Suction Lift Installations



1. Suction lines when operating under lift conditions must be absolutely free from air leaks.
2. Suction piping should gradually slope upward toward the pump.
3. NPSH available must be greater than the NPSH required by the pump.
4. A means of priming the pump, such as a foot valve, must be provided.
5. Pipe must be supported properly to prevent flange loading.
6. Provide adequate submergence over the suction pipe inlet to prevent formation of vortices.

Suction Piping – with Positive Head (Flooded Suction)

1. The suction line must include an isolation valve to close off the source of supply when performing inspection or maintenance on the pump. Install this valve at least two pipe diameters before the pump suction nozzle.
2. Piping should be level or gradually slope downward from the suction source in order to avoid air pockets.
3. Attention should be paid to the design of the exit from the supply source to prevent the formation of vortices or eddies that can draw air into the pump. This relates to the velocity of the outflow and the submergence of the supply exit below the liquid level.

Discharge Piping

1. Discharge piping will normally be larger than the pump discharge size, so a concentric increaser is usually used for adaptation. Locate increaser below check valve.
2. A check valve and isolation valve should be located in the discharge line. The check valve should be located between the isolation valve and the pump. This will prevent back flow through the pump (reverse rotation) and will also serve to reduce any back pressure.
3. If an expansion joint is used, it should be located between the check valve and the pump. Proper anchoring is necessary.

Alignment of Pump/Driver Shafts



Driver power must be locked out before beginning any alignment procedure. Failure to lock out driver power may result in serious physical injury.

Note:

Proper alignment is the responsibility of the installer and user of the equipment.

Note:

Check alignment if process temperature changes, piping changes and/or pump service is performed.

Pump and driver shafts need to be aligned for both parallel and angular alignment. If there is a misalignment of the shafts, it will place a mechanical load on the pump and driver shaft/bearing assemblies as well as the coupling. This will result in vibration, noise and premature failures.



**FIGURE 6
PARALLEL MISALIGNMENT**



**FIGURE 7
ANGULAR MISALIGNMENT**

To bring shafts into alignment, we first need to determine the amount and direction of both parallel and angular misalignments. We can then shim and reposition to correct.

It's preferable to shim **ONLY** under the driver feet since good contact between the pump feet and the base is necessary to resist any pump flange loading that might be imposed by the suction and/or discharge piping.

There are three methods commonly used to determine misalignment:

1. Straight edge and calipers or inside micrometer (least accurate)
2. Dial indicator (reasonably accurate)
3. Laser Alignment Equipment. See manufacturer's instructions for use.

Since any misalignment will impose loads on the pump and driver shafts, the objective is to minimize any misalignment in order to protect the pump and driver and minimize any tendency for vibration. Suggested misalignment limits are:

Table 1

Pump Frame Group	Max. Parallel	Max. Angular
S, M, L	0.005"	0.005"
XL	0.010"	0.010"

For optimum performance and Mean Time Between Pump Maintenance (MTBPM), use alignment limits half of those shown above.

Note:

In any case, disregard the coupling manufacturer's published misalignment limits, as these will impose unacceptable loads on the pump and motor shafts and bearings.

Alignment must be done at several different times:

1. Prior to grouting baseplate during installation
2. After grouting baseplate and tightening anchor bolts
3. After attaching suction and discharge piping prior to initial operation
4. Hot alignment after equipment temperatures have stabilized
5. After pump maintenance if back pull-out assemblies are removed

Since the Model 811 pump is foot-mounted, its shaft centerline will rise when handling pumpage at elevated temperatures. Similarly, the motor shaft centerline will rise as it reaches its operating temperature. Therefore, we will often purposely mis-align shafts vertically during cold alignment to allow for thermal growth, thus bringing the shafts into alignment at operating temperature. This is shown in Table 2 on Page 15.

The Griswold Model 811 is an ANSI B73.1 Process Pump and is, therefore, furnished with a spacer coupling to enable removal of the back pull-out assembly without disturbing the casing or moving the motor driver.

Note:

Alignment is done with the coupling spacer removed.

The most simple alignment check is with a straight edge and calipers or inside micrometer. This method is the least accurate, but it will serve if a dial indicator or laser is not available.

Alignment with Straight Edge and Micrometer



FIGURE 8
ANGULAR ALIGNMENT

With coupling hubs stationary, use inside micrometer or calipers to measure the gap between the coupling hubs at 90° intervals. Adjust and/or shim equipment until the gap difference at all points around the hub(s) is less than the value shown in Table 1 page 13.



FIGURE 9
PARALLEL ALIGNMENT

With coupling hubs stationary, lay straight edge flat against rim of coupling hub to determine vertical and horizontal alignment offsets. Adjust and/or shim equipment until the straight edge lies flat against both hub rims, vertical and horizontal.

The dial indicator method is preferred for checking alignment

Dial Indicator Method



FIGURE 10
DIAL INDICATOR SETUP

1. *Scribe or mark index lines on both coupling hubs to indicate where the dial indicator point rests.*
2. *Set dial indicator to zero.*
3. *Slowly turn BOTH coupling hubs so that the index lines match or the indicator point is always on the mark.*
4. *Observe dial reading to determine required adjustments.*
5. *Acceptable parallel and angular alignment occurs when the total indicator reading (TIR) for a complete turn does not exceed the values shown in Table 1 page 13.*

As previously mentioned, pump and motor shafts need to be in alignment while they are at their intended operating temperature. When the shafts are aligned “cold” (at ambient temperature), we will intentionally position the motor shaft up or down in vertical parallel alignment to allow for thermal growth. Then, when the alignment is checked “hot” (at stable operating temperature), the shafts should be confirmed to be in alignment. Use the values in the following table:

Table 2

Cold Setting of Parallel Vertical Alignment	
Pumpage Temperature	Set DRIVER Shaft, inches
50 ⁰ F	0.002" low
150 ⁰ F	0.001" high
250 ⁰ F	0.005" high
350 ⁰ F	0.009" high
450 ⁰ F	0.013" high
550 ⁰ F	0.017" high
650 ⁰ F	0.021" high
700 ⁰ F	0.023" high

Laser alignment is usually the most accurate method. Follow the laser alignment equipment manufacturer’s instructions for this method.

Drivers

Electric Motors

Connect power supply in conformance with local and national codes. Line voltage and wire capacity must match the ratings stamped on the motor nameplate.



*Severe damage can be done to the pump if it is driven in reverse rotation.
During installation, when the motor is jogged to check rotation,
this MUST be done with the coupling spacer removed.
Do not install coupling spacer until correct motor rotation has been established*

Engine-Drives



Operators must become familiar with the installation and service manual as supplied by the engine manufacturer.

Safe and efficient operation of a pumping unit driven by an engine, whether diesel or gasoline requires the installation to satisfy the following requirements:

1. Be well ventilated in order to keep the ambient temperature as low as possible.
2. Provide ample air for proper combustion.
3. Provide the engine with an efficient exhaust system so that the combustion gases discharge with a minimum of backpressure.
4. Provide for a fuel system of adequate capacity, which meets the local codes.
5. Provide ample accessibility to service engine.
6. Provide engines / drives for correct rotation of the pump. Engine rotation is determined at the factory. No change of engine rotation can be made in the field.

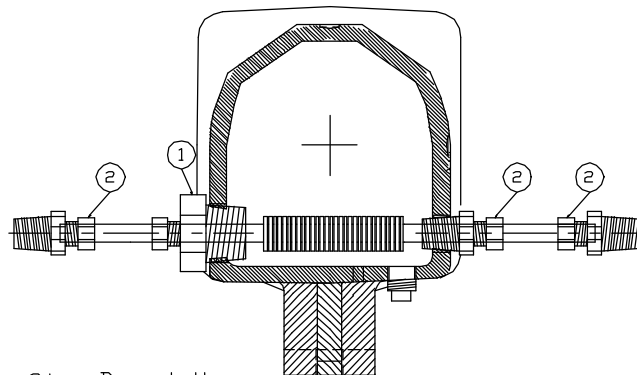
Flushing and Cooling Lines

Pump auxiliaries such as flushing and cooling are application-specific. In general, however, note the following:

Cooling

Bearing cooling is required for applications with pumpage temperature above 350⁰ F or if bearings operate above approx. 180⁰ F. Bearing cooling is accomplished with a finned-tube cooler,

FINNED TUBE COOLER



Item	Qty.	Description
(1)	1	1' NPT x 1/2" Compression Fitting
(2)	3	1/2' NPT X 1/2" Compression Fitting

which is inserted into the oil sump in the bearing frame.

In some instances, mechanical seals are flushed from the pump discharge through a heat exchanger. Cooling water is to be supplied to the “water” side of the heat exchanger.

Flushing

Flushing is usually associated with the shaft sealing and is application specific.

Mechanical seals are usually flushed to prevent localized heating at the seal faces. Flush may be with a bypass line from the pump discharge to the gland flush connection or from the gland flush connection to the pump suction. If the pumpage contains solids or other contaminants the seal may be flushed from an external clear liquid source, usually into the seal gland flush connection.

If packing is used and flushing is required, such as when the pumpage contains minor amounts of solids, which would wear the packing and sleeve, a clean water flush is introduced into the lantern ring connection on the stuffing box cover. This injects water into the lantern ring area between the rings of packing to prevent the intrusion of solids. It's helpful to have a pressure gauge, needle control valve and flow indication device in this flush line to monitor flushing liquid.

If the pump is in a suction lift application, the stuffing box pressure may be less than atmospheric pressure in which case pressurized water should be supplied to the lantern ring connection to effect a water seal. If the pumpage is clean, this may be a bypass line from the discharge of the pump. If the pumpage contains solids, external water injection may be necessary as noted above.

Prior to pump start-up, all cooling and flushing lines (as applicable) must be installed and functional.

PUMP OPERATION

Prior to initial pump start-up, we need to make some checks on the pump and the system.

Pump/Motor Rotation



*Severe damage can be done to the pump if it is driven in reverse rotation.
Do not install coupling spacer until correct motor rotation has been established.*

If motor rotation has not been established, then:



Driver power must be locked out to prevent accidental start-up and to prevent physical injury.

1. With power off and locked out, remove spacer between coupling hubs.
2. Restore power, and momentarily energize (jog) motor to determine rotation. Motor shaft must rotate in direction of arrow on the pump. Correct rotation if necessary.

Note:

With a three-phase induction motor, swapping any two leads can change the rotation direction.

3. Shut off power and lock out.

Then, while the pump is accessible for adjustments, impeller clearance should be checked, as well as pump lubrication.

Impeller Clearance

Impeller clearance is set during factory pump assembly, but it should be checked prior to initial pump start-up, especially if pumpage is at elevated temperature where greater clearances are required. Clearances and adjustment procedures are shown in the Table 3, Page 40. Once clearance has been set and bolts tightened, rotate shaft by hand just to be sure. Expect some drag from the mechanical seal.

Pump Lubrication

The standard lubrication for the Model 811 is flood oil. Lubrication options include oil mist, re-greasable bearings and greased-for-life bearings. See Appendix II for recommended lubricants.



*Pumps with flood oil lubrication are not filled with oil at the factory.
This must be done prior to initial operation and at regular intervals thereafter. Failure to do so will cause bearing failure or pump seizure.*

If re-greasable bearings are supplied, grease fittings are furnished on the bearing frame. Prior to initial start-up, clean any dirt or foreign matter from the grease fittings. Remove grease plugs from the bottom of the frame. Pump grease through the fittings into each bearing cavity until fresh grease comes out of the relief ports. Re-grease bearings every 2000 hours of operation or every three (3) months, whichever occurs first.



Never mix greases of different consistencies or different types.

After the above steps have been completed, install the coupling spacer and install the coupling guard as stated in Appendix IX.

Stuffing Box (Shaft Seal)

For pumps with mechanical seals, the seal has been installed at the factory. No further adjustments are necessary. **If cartridge seals are used, ensure that the positioning clips have either been removed or re-positioned for operation.**

If pump is furnished with packing, check to see that the gland nuts are finger-tight only. Packing must be run in gradually after initial start-up. For proper operation, packing must leak at least approximately 40-60 drops per minute in order to lubricate and cool the packing and shaft sleeve. Once the pump has been placed in operation, the gland nuts should be tightened ¼ turn at a time until the required leakage rate is attained. This may take several hours.



A pump must never be allowed to run dry or without liquid in the seal chamber. Operating a pump without liquid in the casing or seal chamber, even briefly, can result in damage to the mechanical seal, damage to the pump or personal injury.

Priming

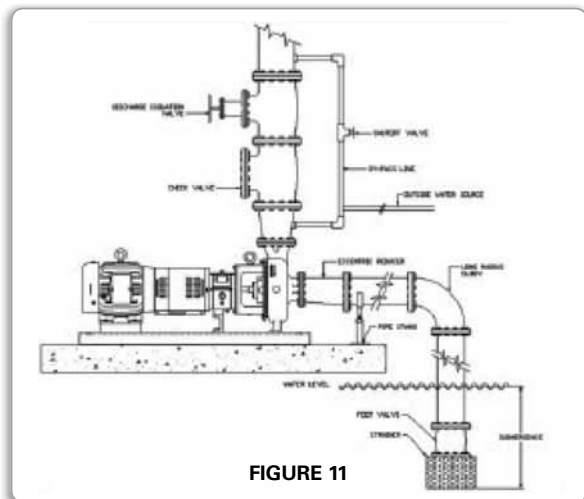


A centrifugal pump must be primed before operation. If run dry, damage can occur to close-clearance parts and the mechanical seal will be destroyed. If not primed, the pump will not deliver liquid.

Systems with Positive Suction Head (Flooded Suction)

Slowly open the suction isolation valve. Open air vents in suction and discharge piping until liquid flows out. Close all vents.

Systems on Suction Lift with Foot Valve



See illustration at left. Note vent location above pump discharge nozzle.

For initial start-up when discharge system is empty, it may be necessary to provide prime with an external, or outside, water source. Once the discharge system is full, re-priming may be done with a bypass as shown.

With vent open, furnish water into the pump and suction piping with either a bypass line from the discharge system or from an outside source. Once liquid escapes from the vent, the pump and suction pipe should be full of liquid (primed).

Systems on Suction Lift without Foot Valve

This will require a source of vacuum (vacuum pump or eductor) to lift water/liquid up through the suction piping AND the pump. Vacuum connection must be located above the pump discharge to completely prime. Once liquid is pulled through the vacuum connection, prime is achieved.

Starting the Pump



DO NOT operate the pump below minimum rated flows or with suction and/or discharge valve closed. These conditions may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury.

1. Re-check motor to ensure that connections are correct. Check that thermal overload relays are properly sized and set for operation.
2. Ensure that the coupling guard and all other safety-related devices and instrumentation are in place and in working order.
3. Be sure that the suction isolation valve is completely open. **Never** use the suction valve to control flow. This can/will lead to “starving” the pump, causing cavitation and vibration and will result in damage to the pump.
4. If pump handles pumpage at temperature greater than 200°F, the pump should be gradually warmed until its temperature is within 100°F of intended operating temperature. Heating rate should not exceed 2.5°F per minute.
5. Ensure that all flushing and cooling lines, as applicable, are attached and operational.
6. Discharge valve should be “cracked” open.

7. Start pump. As soon as the driver comes up to full speed, gradually open the discharge valve allowing the system to fill and stabilize at the pump's operating capacity and head.
8. **Listen** for any untoward noise, check for any significant vibration or indications of binding. If any of these are observed, the pump should be stopped immediately and a thorough check of the installation should be made to determine the cause. Correct any fault(s) prior to re-starting the pump.
9. Check the shaft seal. If pump has mechanical seal(s), there should be no visible leakage. If pump has packing, there should be a steady leakage stream. Packing leakage should be reduced GRADUALLY by tightening the gland nuts $\frac{1}{4}$ turn at a time until a leakage rate of 40-60 drops per minute is achieved. This may take several hours and several adjustments.

Once the pump and motor have reached stabilized operating temperatures, final alignment should be checked.

1. Stop the pump.
2. Lock out the power source.
3. Immediately remove the coupling guard and coupling spacer.
4. Check alignment as described in the "Installation page 12" section.
5. Make any necessary alignment corrections.
6. Re-install coupling spacer and coupling guard.

Troubleshooting

If problems are encountered during start-up or pump operation, refer to the following table for likely causes:

Problem	Likely Cause	Remedy
No liquid delivered	Pump not primed	Re-prime pump, check that suction line is full of liquid
	Suction line obstructed	Remove obstruction
	Impeller clogged	Remove obstruction
	Wrong direction of rotation <i>Note - Possible severe damage!</i>	Check rotation, change if necessary
	Foot valve or suction pipe has inadequate submergence	Check suction source for vortexing, correct as necessary
	Suction lift too high	Review/revise level on suction
Pump does not produce rated flow or head	Air leak through gasket	Replace gasket, tighten connections
	Air leak through stuffing box	Inspect packing/mechanical seal, add pressurized flush if necessary
	Impeller partially clogged	Remove obstruction
	Excessive impeller clearance	Adjust impeller clearance
	Inadequate suction head	Review/revise design
	Worn or damaged impeller	Inspect/replace as necessary
Pump starts then stops pumping	Pump improperly primed	Re-prime pump
	Air or vapor in suction line	Review/revise suction piping to eliminate air pockets
	Air leak in suction line	Check gaskets, repair leak
Bearings run hot	Improper alignment	Re-align pump and driver
	Improper lubrication	Check lubricant for applicability and level/quantity
	Bearing cooling not working	Check cooling water line(s)
Pump is noisy or vibrates	Improper alignment	Re-align pump and driver
	Partial impeller clog/imbalance	Remove obstruction
	Broken or bent impeller or shaft	Replace as necessary
	Foundation not rigid	Tighten hold-down bolts of base, pump and motor. Recheck alignment.
	Worn bearings	Replace as necessary
	Suction and/or discharge piping not anchored correctly	Review design, modify as necessary
	Pump cavitation	Review suction system, correct problem(s)
Excessive stuffing box leakage	Packing gland improperly adjusted	Tighten gland nuts
	Stuffing box not packed properly	Check, re-pack as necessary
	Shaft sleeve scored, ridged	Replace as necessary
	Worn mechanical seal	Replace as necessary
Excessive power required	Actual head lower than design	Throttle discharge valve slightly, trim impeller. Review design
	Liquid heavier than expected	Review design
	Stuffing box packing too tight	Re-pack pump
	Rotating parts binding	Check pump internals

REPAIR MAINTENANCE

Disassembly and Reassembly Warnings

Prior to working on this or any pump note the following safety precautions and warnings:

Warnings and Precautions!	
Lock out power supply.	Close suction and discharge valves.
Pump components can be heavy. Proper lifting methods must be used to avoid physical injury and equipment damage.	Wear steel-toe shoes, safety glasses, gloves and any other required protective clothing.
If the pump contains toxic or hazardous fluids, proper personal protective equipment must be worn.	Toxic or hazardous materials must be handled and disposed of properly in accordance with all applicable environmental regulations.
Never apply heat to remove parts. Trapped liquid may cause an explosion and cause physical injury.	Allow system components to cool before handling.

The Griswold Model 811 is an ANSI B73.1 design, which is back pull-out. The pumping assembly (back pull-out assembly) can be removed from service without disturbing the casing or the driver. An exception to this would be when a C-face adapter is used to support the electric motor and keep the pump and motor shafts in alignment.

Removing Pump from Service

1. Lock out power supply.
2. Close suction and discharge valves.
3. Drain liquid from casing and flush as necessary or required. ***If liquid is toxic or hazardous, wear appropriate protective equipment and handle liquid properly!***
4. Remove coupling guard and coupling spacer as stated in Appendix IX.
5. If oil-lubricated, remove drain plug, drain oil and replace drain plug.
6. Disconnect any flushing or cooling lines.
7. Remove frame foot hold-down bolts.
8. Remove complete back pull-out assembly by removing frame adapter-to-casing bolts (Item 370) and tightening jacking screws (Item 418). Support back pull-out assembly with appropriate lifting device(s).
9. Inspect casing internals for wear.
10. Using suitable lifting device(s), transport back pull-out assembly to maintenance area.



FIGURE 12
BACK PULL-OUT REMOVAL

Disassembly

Required tools:

Open End Wrenches
Snap Ring Pliers
Dial Indicator
Feeler Gages
Bearing Puller
Hydraulic Press

Impeller Wrench
Spanner Wrench
Micrometer
Drift Punch
Rubber Mallet
Cleaning Agents

Induction Bearing Heater
Allen Wrenches
Torque Wrench
Hoist
Screwdriver(s)

Impeller Removal

1. Secure pump/back pull-out assembly to work bench.
2. Scribe line on pump shaft at end of coupling hub and proceed to remove hub from shaft.
3. Remove impeller (Item 101) **Do not apply heat.** Use impeller shaft wrench for S and M frames. (*Note: For L and XL frames use a spanner wrench or other suitable tool that will not mark the shaft.*) Slide wrench over shaft (Item 122) and key (Item 400). Turn impeller clockwise (viewed from impeller end of shaft), to raise wrench off of workbench. Abruptly turn impeller counterclockwise to impact wrench against workbench or block of wood. Repeat as necessary until impeller loosens on shaft threads. Spin off impeller and discard o-ring seal (Item 496A). **Note: Wear Gloves!**



FIGURE 13
IMPELLER REMOVAL

Removal of Stuffing Box Cover – Mechanical Seal Pumps

Seals may be component type or cartridge type. With a cartridge seal, the gland, sleeve and seal rotary and stationary are an assembled unit.

Component Seal



FIGURE 14
STUFFING BOX COVER REMOVAL

1. Remove seal gland stud nuts (Item 355). Separate seal gland (Item 250), and slide gland toward bearing isolator (Item 333A).
2. Remove seal chamber stud nuts (Item 370H).
3. To remove seal chamber (Item 184), slide chamber forward and off of pump shaft.
4. Remove seal rotary together with shaft sleeve (Item 126). Note that seal set screws may have to be loosened. Remove seal rotary from shaft sleeve. Slide seal gland with stationary seat and o-ring gasket off of pump shaft. Be careful not to damage the stationary seat of the seal as it is located in the gland bore.

Cartridge Seal

Refer to seal manufacturer's drawing:

1. Replace seal rotary positioning clips.
2. Loosen seal sleeve axial adjustment set screws.
3. Remove seal gland stud nuts (Item 355).
4. Slide cartridge seal assembly back toward isolator (Item 333A).
5. Remove seal chamber stud nuts (Item 370H).
6. To remove seal chamber (Item 184), slide chamber forward and off of pump shaft.
7. Remove cartridge seal assembly.

Removal of Stuffing Box Cover – Packed Stuffing Box Pumps

1. Remove packing gland stud nuts (Item 355).
2. Remove stuffing box cover stud nuts (Item 370H).
3. Remove stuffing box cover (Item 184) by sliding cover forward and off of pump shaft.
4. Remove packing rings (Item 106) and lantern ring (Item 105).

Removal of Frame Adapter



Frame adapters are used on M, L and XL group pumps. They are not used on 6" S group pumps and ring adapters are on 8" S group pumps.

1. Remove dowel pins (Item 469B).
2. Remove frame-to-adapter bolts (Item 370B).
3. Separate frame from adapter and discard gasket (Item 360D).
4. Do NOT remove the labyrinth seal, or bearing isolator assembly (Item 333A) from the frame adapter. Unless damaged, the o-rings in the isolator do not require service or replacement.

Power End Disassembly – S and M Group Pumps



FIGURE 16
SHAFT/BEARING HOUSING REMOVAL



FIGURE 17
BEARING REMOVAL

1. Remove cap screws (Item 370C), loosen jam nuts (Item 423).
2. Tighten jack bolts (Item 370D) evenly. Bearing housing will begin to back out of frame.
3. Slide shaft assembly, with bearing housing out of bearing frame.
4. Remove all jackscrews and nuts (Item 370D) and (Item 423).
5. Remove and discard bearing housing o-ring (Item 496).

6. Using snap ring pliers, remove bearing retaining ring (Item 361A).
7. Remove bearing housing (Item 134) from shaft by tapping the shaft with a rubber mallet, driving the thrust bearings and shaft assembly through the housing. Do not remove lab seal.
8. Remove bearing lock nut (Item 136) and lock washer (Item 382).

Note:

When pressing bearings off shaft, use force on inner race only.

9. Using an arbor press, remove inboard and outboard bearings. Slide snap ring off shaft after bearings have been removed.
10. Complete disassembly of bearing frame if required. Remove oil fill plug (113A), oil sight glass (408N) and (4) oil mist/grease plugs (408H). Remove oil cooler inlet and outlet plugs (408L) and (408M). On M models, remove frame foot attachment bolts (370F).

Power End Disassembly – L Group Pumps



FIGURE 18
L GROUP
BEARING REMOVAL

L group power ends use a clamp ring (Item 253B) instead of a snap ring to retain the thrust bearing in the bearing housing. Refer to cross-sectional view in Appendix VIII. Extract shaft/bearing housing assembly from frame as with S and M Group pump noted above.

Then...

1. Remove clamp ring by removing clamp ring screws (Item 236A).
2. Remove bearing housing (Item 134) from shaft by tapping the shaft with a rubber mallet, driving the thrust bearings and shaft assembly through the housing. Do not remove lab seal.
3. Remove all jackscrews and nuts, items (Item 370D) and (Item 423). Remove bearing housing o-ring (Item 496).
4. Remove bearing lock nut (Item 136) and lock washer (Item 382).

Note:

When pressing bearings off shaft, use force on inner race only.

5. Using an arbor press, remove inboard and outboard bearings. Remove bearing cover.

Note:

Do not remove oil slinger (Item 248A) from shaft unless it is damaged.

6. Complete disassembly of bearing frame, if required. Remove oil fill plug (113A), oil sight glass (408N) and (4) oil mist/grease plugs (408H). Remove oil cooler inlet and outlet plugs, (408L) and (408M). Remove frame foot attachment bolts (370F).

Power End Disassembly – XL Group Pumps

XL Group pumps are similar to S and M Group Pumps except that the thrust bearing is held into the bearing housing with a bearing cover (Item 109A). See cross-sectional view of XL Frame pumps in Appendix VIII. Extract shaft/bearing housing assembly from frame as with S and M Group pump noted above. Then.....



FIGURE 19
XL GROUP BEARING REMOVAL

1. Remove bearing cover bolts (371C) and bearing cover (109A). Discard o-ring (Item 496). DO NOT REMOVE LABYRINTH SEAL (Item 332A).
2. Using an arbor press, remove inboard bearing (Item 168A).
3. Remove bearing housing (Item 134), by sliding housing over the bearing and

- removing housing from impeller end of shaft.
4. Remove bearing locknut (Item 136) and lock washer (Item 382).

Note:

When pressing bearings off shaft, use force on inner race only.

5. Press outboard bearing (112) off of shaft.

Parts Inspection

ALL PARTS MUST BE INSPECTED BEFORE REASSEMBLY TO INSURE THAT THE REBUILT PUMP WILL PERFORM PROPERLY. EACH PART SHOULD BE EXAMINED FOR SIGNS OF FATIGUE, EXCESSIVE WEAR AND CRACKS. REPLACE ANY WORN PARTS IF THEY DO NOT MEET THE FOLLOWING TOLERANCE STANDARDS.

Bearing Frame and Foot - Visually inspect for cracks, roughness, rust or scale. Check machined surfaces for pitting or erosion.

Bearing Frame - Inspect tapped connections for dirt. Clean and chase threads as necessary. Remove all loose or foreign material. Inspect lubrication passages to be sure that they are open. Inspect inboard bearing frame bore (bearing fit). Tolerances shown in Appendix.

Shaft and Sleeve - Visually inspect. Check for grooves or pitting. Check bearing fits and shaft runout. Replace shaft and sleeve if worn, or if tolerances are greater than 0.002”.

Casing - Visually inspect for signs of wear, corrosion, or pitting. The casing should be replaced if wear exceeds 1/8" deep. Check gasket surface for signs of corrosion or irregularities.

Impeller - Visually inspect impeller vanes for wear, erosion or corrosion damage. If vanes are worn more than 1/8" deep, or if they are bent, the impeller should be replaced.

Frame Adapter - Visually inspect for cracks, warpage or corrosion damage. Replace if any of these signs appear.

Bearing Housing- Visually inspect for signs of wear or corrosion. Check for cracks and/ or pits. Check tolerances as noted in Appendix III. Replace if worn or out of tolerance.

Seal Chamber/Stuffing Box Cover - Visually inspect for cracks, pitting, erosion or corrosion. Check face of cover for wear, scoring or grooves. Replace if worn more than 1/8" deep.

Shaft – Check shaft for evidence of corrosion or wear. Check shaft diameters in bearing fit areas. See Appendix III for dimensions and tolerances. Check shaft for straightness. Maximum TIR at sleeve journal and coupling journal should not exceed 0.002 inches.

Power End Assembly – S and M Frame Pumps

Replace all plugs that had been removed during disassembly. Replace sight glass. Use thread sealant. Replace frame foot.

1. Install outboard bearing (Item 112) on shaft. If bearings are grease lubricated install single shielded bearing with shield toward the impeller. Bearings can be pressed on the shaft with an arbor press or, if available, an induction heater can be used. Follow all instructions and recommendations of the heater manufacturer. When using a press, make sure that force is applied to the inner bearing race only.
2. Install bearing lock washer (Item 382) on shaft. Place tang of lock washer in shaft keyway under bearing.
3. Thread locknut (Item 136) onto shaft. Tighten nut with a spanner wrench until snug. Bend any tang of lock washer over flat on nut. Slide bearing retaining snap ring (Item 361A) over shaft, flat side toward the bearing. Maximum locknut torque values are shown in the Appendix V, Page 46.
4. Install inboard bearing (Item 168A). If using a press, make sure force is applied on inner bearing race only. NOTE: If bearing is grease lubricated, it has a single shield. The bearing is installed with the shield away from the impeller.
5. Install new o-ring (Item 496) on bearing housing (Item 134). Apply a thin coat of oil on the outside of the bearing and the inside of the bearing housing. Lightly lubricate the shaft to assist with the installation of the labyrinth seal o-ring.
6. Slide coupling end of pump shaft through bearing housing. Press housing evenly until bearing seats against shoulder in bearing housing. **DO NOT FORCE. Support outer face of bearing isolator to prevent accidental separation of rotor from stator.**
7. Install bearing snap ring (Item 361A) in groove in bearing housing bore.

Note:

Locate ends of snap ring so that they do not obstruct the flow of oil through the return groove. Rotate shaft to make sure that it turns freely.

8. Apply thin film of lubricant to outside of bearing housing (Item 134).
9. Apply thin film of lubricant to frame bore ID. Install shaft assembly into bearing frame (Item 228). Rotate shaft to make sure that it turns freely.
10. Install cap screws (Item 370C) into bearing frame (Item 228). Install jack bolts (Item 370D) and lock nuts (Item 423). Hand tighten evenly.
11. On M frames, install new gasket in frame face (Item 360D).

Power End Assembly – L Frame Pumps

The L frame is similar to the S and M frames except that the thrust bearing is retained in the bearing housing by an end cover and screws rather than a snap ring. The thrust bearing is a duplex angular contact type. It also uses an oil slinger. Replace all plugs that had been removed during disassembly. Replace sight glass. Use thread sealant. Replace frame foot.

1. If removed, install oil ring (Item 248A) on shaft.

Note:

Oil Slinger is a press fit onto the shaft. Use proper size drive tool to prevent damage.

2. Install bearing cover (Item 253B) over shaft.
3. Install outboard bearings (Item 112).

Note:

L frame uses a duplex angular contact bearing. Be sure bearing(s) are installed in correct order, i.e. back-to-back. The bearing model numbers should face away from each other. If a press is used, be sure that force is applied to inner race only.

Note:

Install bearing lockwasher and locknut as described for S and M Group pumps on previous page.

4. Install inboard bearing (Item 168A).

Note:

When pressing bearings on shaft, use force on inner race only.

5. Lightly lubricate the outside of the outboard bearing (Item 112), the bearing housing bore and the coupling end of the shaft. Slide the bearing housing (Item 134) over the shaft and over the outboard bearing. DO NOT FORCE.
6. Install bearing cover bolts (Item 236A). Tighten bolts to 55 in.-lbs. for lubricated threads or 83 in.-lbs. for dry threads. Check that shaft rotates freely.
7. Install new bearing housing o-ring (Item 496).
8. Lightly lubricate outside surface of bearing housing and ID of bearing frame bore. Install shaft and bearing assembly into frame. Check that shaft rotates freely.
9. Install cap screws (Item 370C) into bearing frame (Item 228). Install jack bolts (Item 370D) and lock nuts (Item 423). Hand tighten evenly.

Power End Assembly – XL Frame Pumps

Replace all plugs that had been removed during disassembly. Replace sight glass. Use thread sealant.

1. Install outboard bearing (Item 112) on shaft.

Note:

When pressing bearings on shaft, use force on inner race only.

2. Install bearing lock washer (Item 382) on shaft. Place tang of lock washer in shaft keyway under bearing. Thread locknut (Item 136) onto shaft and tighten until snug. Bend a tang of the lock washer over a flat on the lock nut.
3. Lightly lubricate the outside of the outboard bearing and the bearing housing bore. Slide bearing housing over shaft and onto the outboard bearing. DO NOT FORCE.
4. Lightly lubricate coupling end of shaft. Install bearing cover (Item 109C) and gasket (Item 360C). Tighten bearing cover bolts (Item 371C) to 12 ft.-lbs. for dry threads or 9 ft.-lbs. for lubricated threads.
5. Install inboard bearing (Item 168A) on shaft.

Note:

When pressing bearings on shaft, use force on inner race only.

6. Install new bearing housing o-ring (Item 496).
7. Lightly lubricate outside of bearing housing and ID of bearing frame bore. Install shaft and bearing assembly into frame. Check that shaft rotates freely.
8. Install cap screws (Item 370C) into bearing frame (Item 228). Install jack bolts (Item 370D) and lock nuts (Item 423). Hand tighten evenly.
9. Replace frame foot (Item 241) and hand tighten bolts (Item 370F).

Power Frame Checks for Liquid End Assembly



FIGURE 20
BEARING END PLAY CHECK

Check Shaft Endplay

Place the power frame in the horizontal position. Support frame assembly so that it does not tip over. Check shaft endplay by moving shaft forward and backward by hand. Dial indicator movement should be within tolerances below:

Frame	Endplay, inches
S	0.0011 – 0.0019
M	0.0013 – 0.0021
L	0.0010 – 0.0015
XL	0.0014 – 0.0023



FIGURE 21
SHAFT RUNOUT CHECK

Check Shaft Runout

1. Install shaft sleeve (Item 126).
Install impeller (Item 101) on shaft (Item 122).
2. Position dial indicator as shown at left.
3. Rotate shaft one full revolution and check for shaft/sleeve run out.
4. If total indicator reading (TIR) is greater than 0.002", disassemble and determine cause – correct.



FIGURE 22
FRAME FACE RUNOUT CHECK

Check Frame Face Runout

1. Attach dial indicator to shaft.
2. Place indicator against face of frame as shown at left.
3. Rotate shaft by hand so that indicator sweeps the entire fit for 360 degrees. Maximum indicator runout should be no more than 0.005 inch. If greater, disassemble and determine cause.

Power Frame Checks for Liquid End Assembly

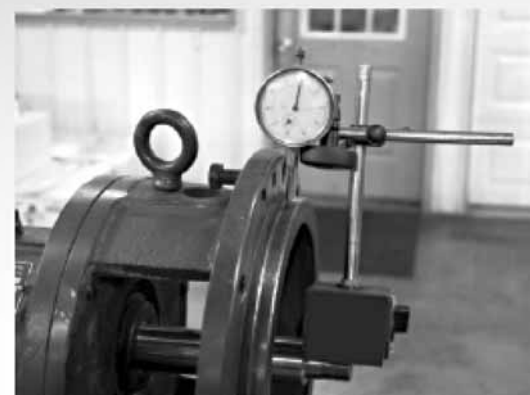


FIGURE 23
ADAPTER FACE RUNOUT CHECK

Check Adapter Face Runout

1. Install adapter gasket (360D) on frame face.
2. Install frame adapter (108) with bearing isolator seal (333A, M frame only) onto the power end assembly. Make sure shouldered fit of adapter fits inside of recess of the power frame. Align bolt holes and dowel pin holes. Install dowel pins (469B) and frame-to-adapter bolts (370B). Tighten evenly in a crisscross manner.
3. Attach dial indicator to shaft. Place indicator against mating face of adapter. Rotate shaft 360 degrees. Total indicator runout should not exceed 0.005. With dial indicator still attached to shaft, position indicator on inside diameter of mating face. Rotate shaft again a full 360 degrees. Total indicator runout should not exceed 0.005 inch. If greater values are measured, disassemble and determine cause before proceeding with assembly.



FIGURE 24
STUFFING BOX COVER RUNOUT CHECK

Check Stuffing Box Cover Runout

1. Install stuffing box cover (Item 184) with studs and nuts (Items 370H, 423B).
2. Mount dial indicator as shown. Rotate shaft 360°. Maximum dial indicator runout should not exceed 0.005" for outside diameter of pilot fit, face of casing gasket surface and stuffing box cover face.

If greater values are measured, disassemble and determine cause before proceeding with assembly.



FIGURE 25
IMPELLER RUNOUT CHECK

Check Impeller Runout

1. Install shaft sleeve (if used) and impeller. Lightly tighten impeller onto shaft.
2. Attach dial indicator to flange of frame adapter. Position indicator on tip of impeller vane. Rotate shaft 360 degrees. Check impeller run out from vane tip to vane tip. Total indicator runout should be less than 0.005 inch.

If greater values are measured, disassemble and determine cause before proceeding with assembly.



FIGURE 26
PRELIMINARY IMPELLER ADJUSTMENT

Preliminary Impeller Adjustment

1. Loosen clamp bolts (370C) and jacking bolts (370D). Adjust impeller travel such that the gap between the impeller (101) and the stuffing box cover (184) is 0.030".
2. When 0.030" gap is reached, tighten clamp bolts, jacking bolts and locking nuts (423).

Note:

This approximates the impeller position for final impeller clearance adjustment.

I. For Pumps with Component Mechanical Seals

1. Apply a bluing solution to the shaft sleeve and scribe a mark on the sleeve at the face of the seal chamber/stuffing box cover. This locates the seal setting reference point for the installation of the mechanical seal rotary unit. See mechanical seal manufacturer's dimension print for the seal to be used.
2. Remove the impeller and shaft sleeve. Remove stuffing box cover.
3. Install the mechanical seal stationary seat into the mechanical seal gland (250). Follow the seal manufacturer's instructions. Slide the seal gland with the stationary seat over the shaft and locate back towards the bearing frame.
4. Install the seal rotary unit on the shaft sleeve following the seal manufacturer's instructions. Re-install the sleeve, with seal rotary, on the pump shaft.
5. Install stuffing box cover (184) with studs and nuts (370H and 423B).
6. Install impeller with o-ring, being sure to firmly tighten it clockwise.
7. Install mechanical seal gland (250) over studs with nuts (353A). Tighten nuts evenly. Check shaft for free rotation. If any binding or rubbing occurs, determine cause and correct before proceeding.

II. For Pumps with Cartridge-type Mechanical Seals

Cartridge seals unitized, i.e., the gland, sleeve, seal rotary and seal stationary are pre-assembled and seal compression is pre-set at the factory. Seal faces are held in position for assembly into the pump with positioning screws or clips. Since a cartridge seal includes its own shaft sleeve, solid pump shafts (no sleeve) are often used to lower shaft deflection.

After the preliminary impeller adjustment is made (previous page):

1. Remove impeller and stuffing box cover.
2. Install cartridge seal assembly over the pump shaft (or pump shaft sleeve, if used) being careful to not damage the o-ring located in the ID of the seal's shaft sleeve. Locate the seal assembly back towards the bearing frame.
3. Install stuffing box cover (184) with studs and nuts (370H and 423B).
4. Install impeller with o-ring, being sure to firmly tighten it clockwise.
5. Install the cartridge seal assembly over the studs with nuts (353A). Tighten nuts evenly.

Note:

The axial position of a cartridge seal is set after the back pull-out assembly has been installed in the pump casing and the running impeller clearance has been established.

Refer to the seal manufacturer's drawing and instructions for location of positioning setscrews. Tighten seal positioning setscrews and then remove positioning clips or screws. Check shaft for free rotation. If any binding or rubbing occurs, determine cause and correct before proceeding.

III. For Pumps with Packed Stuffing Box

For proper operation, packing must leak to provide lubrication and cooling. Packing should be gradually run in until a leakage rate of at least 40-60 drops per minute is achieved. Do not attempt to eliminate leakage by over-tightening the gland nuts. If any solids are present in the pumpage, it will be necessary to provide a clean liquid flush to the lantern ring connection in the stuffing box cover (flushes between the rings of packing).

After the preliminary impeller adjustment is made (page 33):

1. Remove impeller leaving the shaft sleeve in place.
2. Re-install the impeller with its o-ring, being sure to tighten it firmly (tightens clockwise).
3. Install packing in the stuffing box. Stagger the packing ring joints at 90° intervals. Two rings should be located at the bottom of the stuffing box, followed by the lantern ring, then followed with three additional rings. Be sure the lantern ring is located under the lantern ring flush connection. Otherwise, flushing liquid, if used, cannot enter between the packing rings.
4. Install the packing gland halves (107) and tighten the gland nuts (353A) finger-tight only.

Note:

When the pump is initially run, there will be a relatively high leakage rate from the stuffing box and this is to be expected. As the packing runs in, the gland nuts may be tightened gradually until the required leakage rate (40-60 drops per minute) is reached. It is suggested that the gland nuts be tightened ¼ turn at a time every 2-3 hours during the run-in period.

Installation of Back Pull-out Assembly

Note:

Use proper lifting methods and equipment to avoid physical injury and/or damage.

1. Inspect casing. Clean casing fit and install gasket (351) into case (100).
2. Loosen cap screws (390C) and jacking bolts (370D). Install back pull out assembly into casing.
3. Apply anti - seize compound to casing bolts (370). Install casing bolts hand tight. Torque casing bolts to values shown in Appendix V, Page 46.
4. Check lateral movement (travel) of impeller in casing. Interference indicates defective parts, improper installation or presence of pipe strain. Determine cause and correct before proceeding.
5. Set impeller clearance as described in the Appendix I, Page 40.
6. Check shaft rotation by hand. If binding or rubbing is present, determine the cause and correct before proceeding.
7. Re-connect cooling and/or flushing lines.
8. Check lubrication. If flood oil (standard), fill with suitable oil. See lubrication chart Appendix II, page 42.
9. Check rotation.
10. Re-install coupling/coupling spacer.
11. Check alignment.
12. Re-install coupling guard. Appendix IX, page 52.

Proceed with pump start-up as noted in the “Operation” Section, Page 20.

ROUTINE AND PREVENTIVE MAINTENANCE

A routine maintenance program can and will extend the life of your pump. Well-maintained equipment will last longer and require fewer, less expensive repairs. You should keep detailed maintenance records as this is helpful in diagnosing problems and the potential causes of problems.

Routine monitoring practices should include, as a minimum:

- Bearing and lubricant condition – bearing temperatures, lubricant level, vibration. If flood oil lubrication, oil level should be at the mid-point of the bull's-eye sight glass. Lubricant should be clear with no signs of frothing. Changes in bearing temperature may indicate imminent failure.
- Shaft seal condition – mechanical seals should show no visible leakage. Packing, if used, should leak at a rate of about 40-60 drops per minute.
- Overall pump vibration – imminent bearing failure can be preceded by a change in bearing vibration. Other vibration can arise due to a change in alignment, the presence of cavitation or resonances between the pump, its foundation or valving in the suction and/or discharge lines.
- Pump discharge pressure – actually pumps should be provided with gauges on both the suction and discharge. The difference between the gauge readings will indicate the total developed head of the pump. A gradual decrease in the developed head of the pump will indicate an opening of the impeller clearance and the need for impeller clearance adjustment to maintain design pump performance.

Quarterly Maintenance

Every three months, the following inspections should be done:

- Check foundation and hold-down bolts for tightness.
- Oil should be changed every 3 months or 2000 operating hours, whichever comes first.
- Shaft alignment should be checked.

Annual Maintenance

The pump's performance should be measured in detail at least once per year. It's helpful to establish performance benchmarks during the early stages of pump operation while parts are new and installation adjustments are correct. This data should include:

- Pump developed head as measured by suction and discharge gauges.
- Pump flow rate – This may be difficult to define in most installations. However, it's nice to know.
- Motor amp draw
- Vibration signature

When an annual assessment of pump performance is made, any changes in the above data may be helpful in determining maintenance that may be required.

Maintenance and monitoring intervals should be shortened if the pump is applied in especially severe service such as highly corrosive liquids or applications with measurable amounts of solids.

Lubrication Topics

All bearings will fail eventually, and the cause is usually a failure of the lubricating medium, not fatigue. Particular attention needs to be paid to this in order to maximize bearing life. The standard lubrication for the Model 811 is flood oil. Provisions are made on the pump for use of regreasable bearings and also for application of oil mist systems.

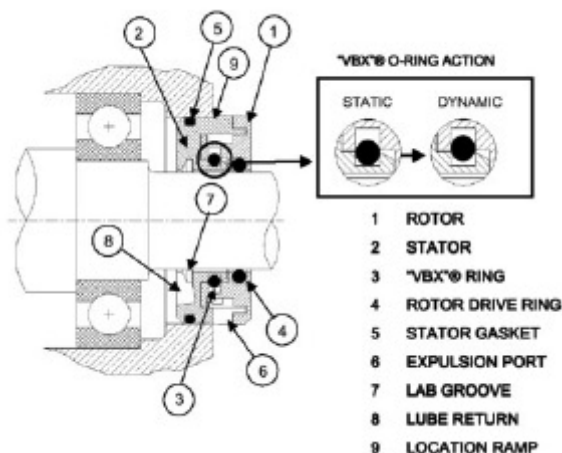
Listings of suitable oils and greases are shown in the Appendix II, page 42.

With flood oil lubrication, the proper level is at the mid-point of the bull's-eye sight glass on the side of the bearing frame. Avoid over-lubrication. It can be just as bad as under-lubrication. Excess oil will cause a slightly higher HP draw and will generate heat. Any extra heat is not a good thing. It can also cause frothing of the oil. After the initial start-up of the pump, or after a bearing change-out, the oil should be changed after 200 hours of operation and every 2000 hours (or three months) thereafter. If any cloudiness is observed in the oil, it's indicative of water greater than 2000 PPM concentration. The oil needs to be changed immediately. The most common cause of water contamination is condensation.

If the pump is furnished with regreasable bearings, note that the shields must be located toward the interior of the bearing frame. Bearings should be regreased every 2000 hours of operation or three months, whichever comes first. When regreasing, be sure that the grease fittings are absolutely clean. Any contamination will decrease bearing life dramatically. Avoid overgreasing as this can cause localized high temperatures in the bearing races and create caked solids which are not good. After regreasing, bearings may run at a slightly higher temperature for a period of one to four hours. Remove grease plugs (408H) from the bottom of the frame. Pump grease through the fittings into each bearing cavity until fresh grease comes out of the relief ports.



Never mix greases of different consistencies or different types.



Bearing Isolators

The Model 811 pump is furnished with Inpro® bearing isolators. These labyrinth seals are very effective at keeping oil in the bearing frame and keeping contaminants out. For proper operation, the drain hole needs to be at the bottom (six o'clock position). This is a non-contacting seal and, therefore, has a theoretically infinite life. Due to its close clearances, however, it can be damaged through an outright bearing failure. Its rotor is driven by a replaceable o-ring, which fits

onto the pump shaft. The stator OD is sealed with a replaceable o-ring. There is another o-ring, which is internal to the seal that cannot be replaced, so the seal should be treated as an assembly, replaced as an assembly if necessary.

SPARE PARTS

We recommend that, as a minimum, the following parts be kept on hand as spares:

Part Description (Item Number) – refer to pump cross-sectional view in Appendix VIII, page 49.

Recommended Spares – All Pumps	
Impeller (101)	Bearing Lockwasher (382)
Shaft (122A)	Bearing Locknut (136)
Shaft Sleeve (126), if used	Impeller O-ring (412A)
Outboard, Thrust Bearing (112A)	Bearing Housing O-ring (496)
Inboard, Radial Bearing (168A)	Outboard Lab Seal Rotary O-ring (497)
Casing Gasket (351)	Outboard Lab Seal Stationary O-ring (497G)
Frame-to-Adapter Gasket (360D)	Inboard Lab Seal Rotary O-ring (497H)
Bearing Housing Retaining Ring (361A)	Inboard Lab Seal Stationary O-ring (497J)

Recommended Spares – By Pump Application	
<i>If Packed Stuffing Box Is Used:</i>	<i>If Mechanical Seal Is used:</i>
Lantern Ring Half (105), Qty 2	Spare mechanical seal, per application
Packing Set (106), 5 rings	
Packing Gland (107)	

Whenever a pump is dis-assembled, parts that have been under compression such as gaskets and o-rings should be replaced during re-assembly. In this regard, maintenance kits are available which contain a complete set of gaskets and o-rings for a given pump repair. This packaging may be helpful in maintaining required parts in stores.

Ordering Parts

Parts are available through your local authorized Griswold distributor. Please provide serial number for accurate identification.

APPENDIX - I

Impeller Clearance Adjustment



WARNING

Drive power must be locked out to prevent accidental start-up and physical injury.

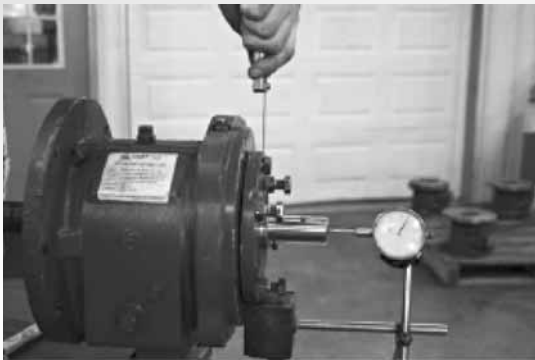


FIGURE A-1
FEELER GAUGE METHOD

Feeler Gauge Method

1. Lock out power supply to motor.
2. Remove coupling guard and coupling spacer.
3. Loosen jack bolts (370D) and jam nuts (423).
4. Tighten bearing housing bolts (370C) evenly, while slowly rotating the shaft until the impeller just starts to rub on the casing.
5. Using a feeler gauge set the gap between the three housing bolts (370C) and the bearing housing. Set the gap according to the table, below, as required.
6. Tighten jacking bolts (370D) evenly, until

bearing housing backs out and contacts the bearing housing bolts (370C).

7. Tighten jam nuts (423) evenly. Rotate shaft to make sure that it turns freely.
8. Reinstall coupling spacer and coupling guard.

Dial Indicator Method



WARNING

Drive power must be locked out to prevent accidental start-up and physical injury.

1. Lock out power supply to motor.
2. Remove coupling guard and coupling spacer.
3. Place a dial indicator with a magnetic mounting base on the surface of the pump baseplate. Position indicator against face of pump shaft.
4. Loosen jacking bolts (370D) and jam nuts (423).
5. Tighten bearing housing bolts (370C) evenly, while slowly rotating the shaft until the impeller just starts to rub on the casing. Set dial indicator to zero.
6. Tighten the jacking bolts (370D) evenly, until they contact the bearing frame. Continue to tighten the jacking bolts evenly, about one flat at a time, drawing the bearing housing away from the frame until the dial indicator shows the proper clearance

7. Tighten bearing housing bolts (370C) evenly, and then tighten jacking bolts (370D) evenly. Make sure dial indicator reading does not move from the proper setting. Rotate shaft to make sure that it turns freely.
8. Reinstall coupling spacer and coupling guard.

Table 3

Impeller Clearance at Ambient for Various Service Temperatures, inches				
Pumpage Temperature	Pump Frame Size			
	S	M, L	Low Flow	XL
-20 ⁰ to 200 ⁰ F	0.005"	0.008"	.018"	0.015"
Up to 250 ⁰ F	0.006"	0.009"	.019"	0.016"
Up to 300 ⁰ F	0.007"	0.010"	.020"	0.017"
Up to 350 ⁰ F	0.009"	0.012"	.022"	0.019"
Up to 400 ⁰ F	0.010"	0.013"	.023"	0.020"
Up to 450 ⁰ F	0.011"	0.014"	.024"	0.021"
Up to 500 ⁰ F	0.012"	0.015"	.025"	0.022"

APPENDIX - II

Recommended Lubricants

Lubricating Oil Requirements		
	Pumpage temperature < 350 ⁰ F	Pumpage temperature > 350 ⁰ F
ISO Grade	VG 68	VG 100
Approx. SSU @ 100 ⁰ F	300	470
DIN 51517	C68	C100
Kinematic Viscosity @100 ⁰ F mm ² /sec	68	100

Note:

Use non-foaming and non-detergent oils only.

Some acceptable lubricating oils:

Chevron	GTS Oil 68
Exxon	TERRESTIC 68 or NUTO H68
Mobil	DTE Heavy-Medium
Philips	Mangus 315
Shell	Tellus Oil 68
Sunoco	Sunvis 968
Amoco	Amoco Industrial #68
Royal Purple	SYNFILM ISO VG68

Change oil after 200 hours of initial operation, then every 2000 hours or three (3) months thereafter, whichever occurs first.

Bearing Frame Oil Capacity	
Frame	Pints
S	1.0
M	2.6
L	3.0
XL	7.4

Note:

Capacities are approximate. Do not over fill the oil sump as this will cause overheating and damage the bearings. Fill to the centerline of the sight glass.



Never mix greases of different consistencies or different types.

For re-greaseable bearings:

Lubricating Grease Requirements		
	Pumpage temperature < 350 ⁰ F	Pumpage temperature > 350 ⁰ F
NGLI Consistency	2	3
Mobil	Mobilux EP2	SCH32
Exxon	Unirex N2	Unirex N3
Sunoco	Multipurpose 2EP	
SKF	LGMT 2	LGMT 3

Re-grease bearings every 2000 hours or three (3) months, whichever occurs first

APPENDIX - III

Bearing Fits and Tolerances

In accordance with ABEC I Standard

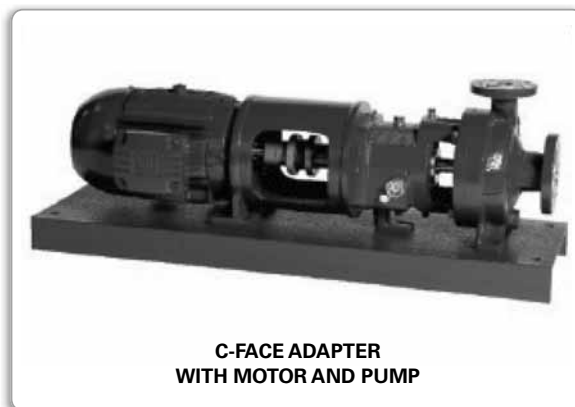
Bearing Fits, Inches					
		S Frame	M Frame	L Frame	XL Frame
Radial Bearing (Inboard)	Shaft OD	1.3785	1.7722	2.1660	2.5597
		1.3781	1.7718	2.1655	2.5592
	Bearing ID	1.3780	1.7717	2.1654	2.5591
		1.3775	1.7712	2.1648	2.5585
	Frame/Adapter ID	2.8346	3.9370	4.7244	5.5118
		2.8353	3.9379	4.7253	5.5128
	Bearing OD	2.8346	3.9370	4.7244	5.5118
		2.8341	3.9364	4.7238	5.5111
Thrust Bearing (Outboard)	Shaft OD	1.1815	1.7722	1.9690	2.5597
		1.1812	1.7718	1.9686	2.5592
	Bearing ID	1.1811	1.7717	1.9685	2.5591
		1.1807	1.7712	1.9680	2.5585
	Bearing Housing ID	2.8346	3.9370	4.3307	5.5118
		2.8353	3.9379	4.3316	5.5128
	Bearing OD	2.8346	3.9370	4.3307	5.5118
		2.8341	3.9364	4.3301	5.5111

APPENDIX - IV

C-Face Adapter

The C-Face motor adapter attaches to the rear of the bearing frame of the pump. This feature enables a C-flange motor to be attached and ensures alignment between the pump and motor shafts.

The C-Face motor adapter may have a mounting foot with an overhung motor or the motor may be supported on its own feet where the adapter is unsupported.



Disassembly

Remove guard.

Remove the motor by loosening the motor mounting bolts (371).



The motor may be heavy and should be properly supported with a clean, uncorroded eye bolt or a strap under both end bells.

Remove the C-Face adapter (340) from the pump-bearing frame (228A) by loosening the four bolts (371N) attached to the bearing frame flange.

Inspect the adapter for signs of corrosion, cracking, scale or debris. Clean accordingly.

Note:

It is not necessary to remove the pump and motor coupling hubs.

Reassembly

Mount both the pump and motor coupling hubs if not already mounted.

Slide the C-Face adapter (340) over the pump shaft (122) and mount against the pump bearing frame (228A) flange using four bolts (371N). Torque bolts to the values shown in table.

Mount the motor to the C-Face adapter (340) using the four or eight motor bolts (371). Torque bolts to the values shown in table. Reinstall guard.

C-Face Adapter Bolting Torque, Ft.-Lbs.			
Bolt	Frame	Dry	Lubed
Adapter to Pump Frame	S	30	20
	M	30	20
	L	30	20
Motor to Adapter	143TC-145TC	12	8
	182TC-286TC	30	20
	324TC-365TC	59	39

APPENDIX - V

Bolt Torque Values

Bolt Torque, Ft.-Lbs. (except where noted)					
	Frame	DI Casing		Alloy Casing	
		Dry	Lubed	Dry	Lubed
Casing Bolt (370)	8" S	30	20	54	35
	6" S	59	39	107	71
	M				
	L				
	XL				
	XL-17	170	113	212	141
Frame-Adapter (370B)	All	Dry – 30 Lubed - 20			
Bearing Clamp Ring (236A)	L	Dry – 83 in.-lbs. Lubed – 55 in.-lbs.			
Bearing End Cover (370G)	XL XL-17	Dry – 12 Lubed - 9			

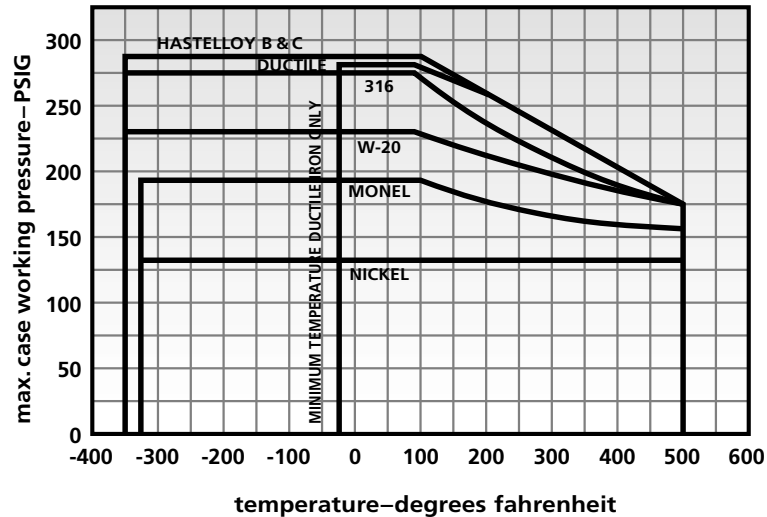
Bearing Locknut Torque Values

Maximum Bearing Locknut Torque, Ft.-Lbs.			
Frame	Bearing Size	Locknut Size	Maximum Torque
S	5306A/C3	N-06	20
M	5309A/C3	N-09	50
L	7310BECBM	N-10	70
XL	5313A/C3	N-13	140

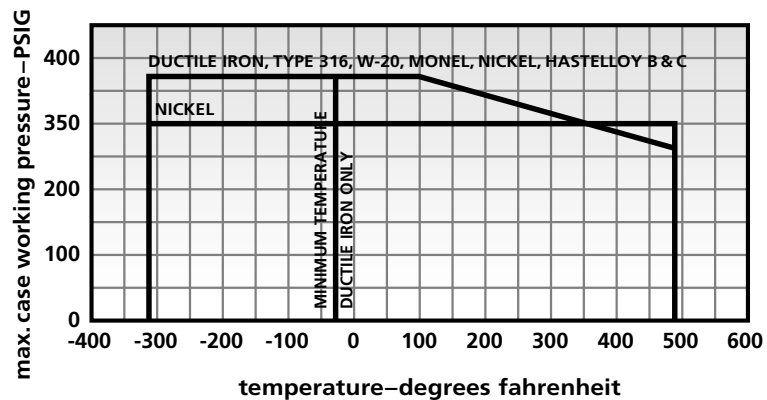
APPENDIX – VI

Pressure – Temperature Ratings

Maximum Working Pressure Limits models 811S, 811M, 811L; Class 150 Flanges



Maximum Working Pressure Limits models 811S, 811M, 811L; Class 300 Flanges



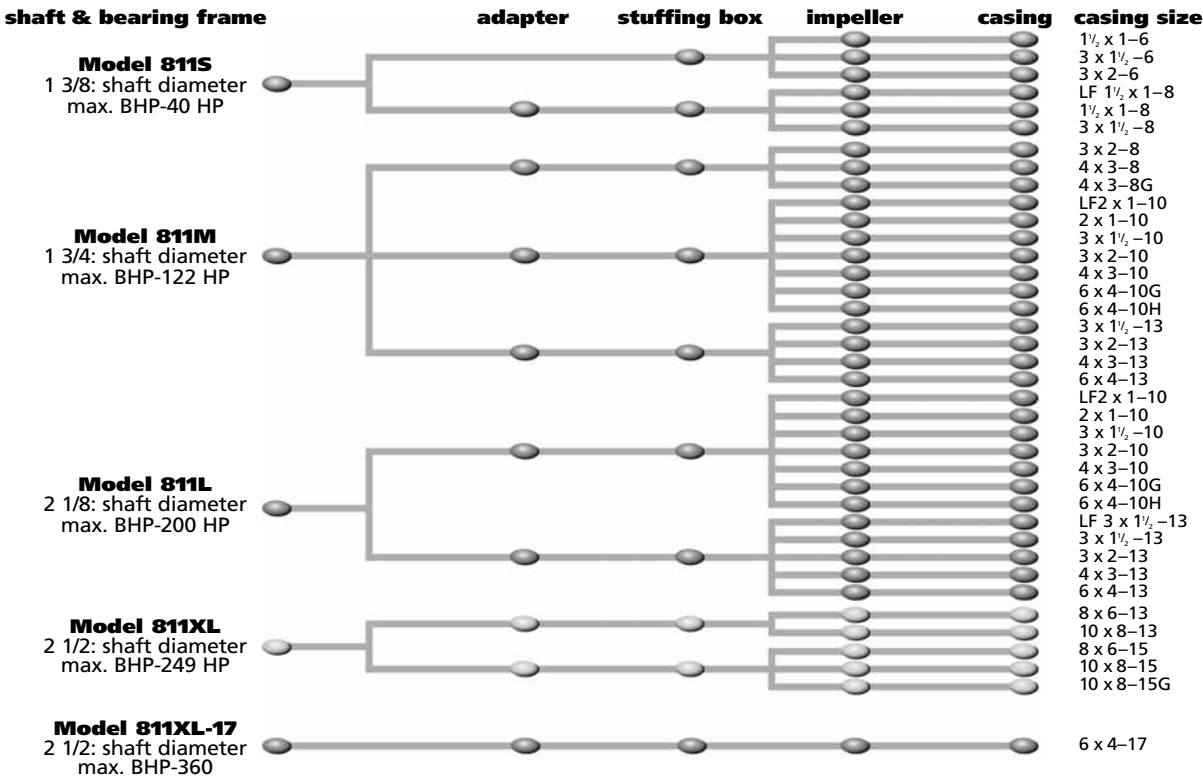
Note: Final selections must be based on temperature and pressure limits given in general data section.

APPENDIX - VII

Parts Interchangeability Chart

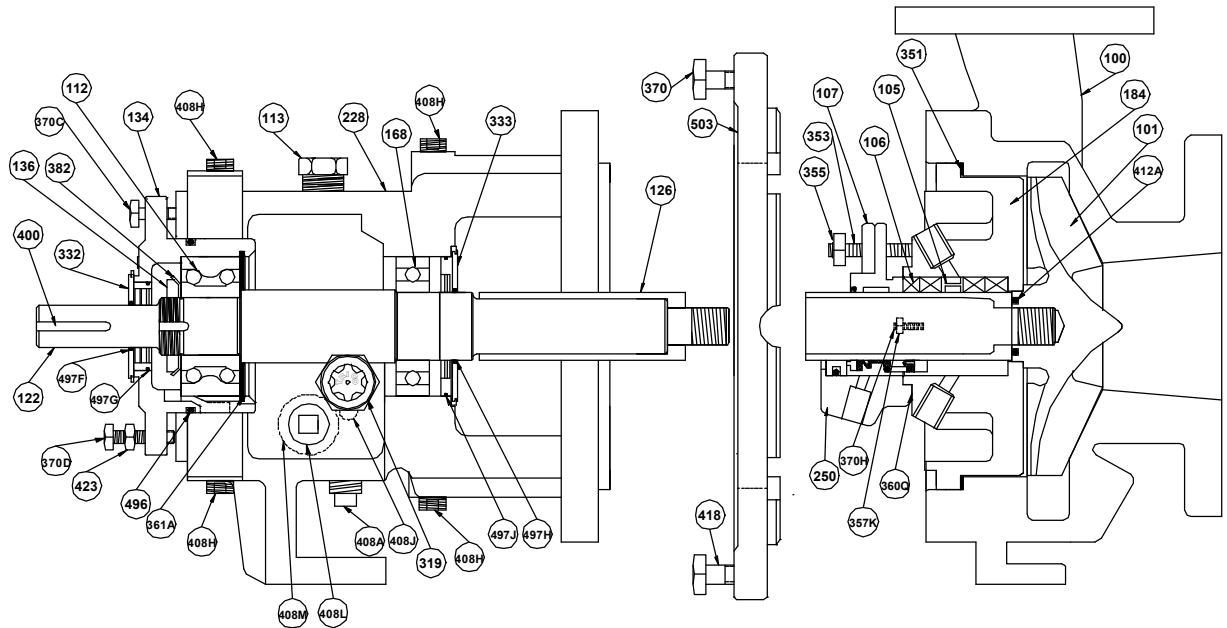
Casings and impellers are unique for each pump size. Stuffing box covers and adapters (except for “S” frames) are shared by casing class, e.g. 10" casings for pump sizes 1 x 2 – 10, 2 x 3 – 10, 3 x 4 – 10, etc. Frame parts are interchangeable within each frame group, e.g. “S” Frame, “M” Frame, etc.

componentinterchangeability

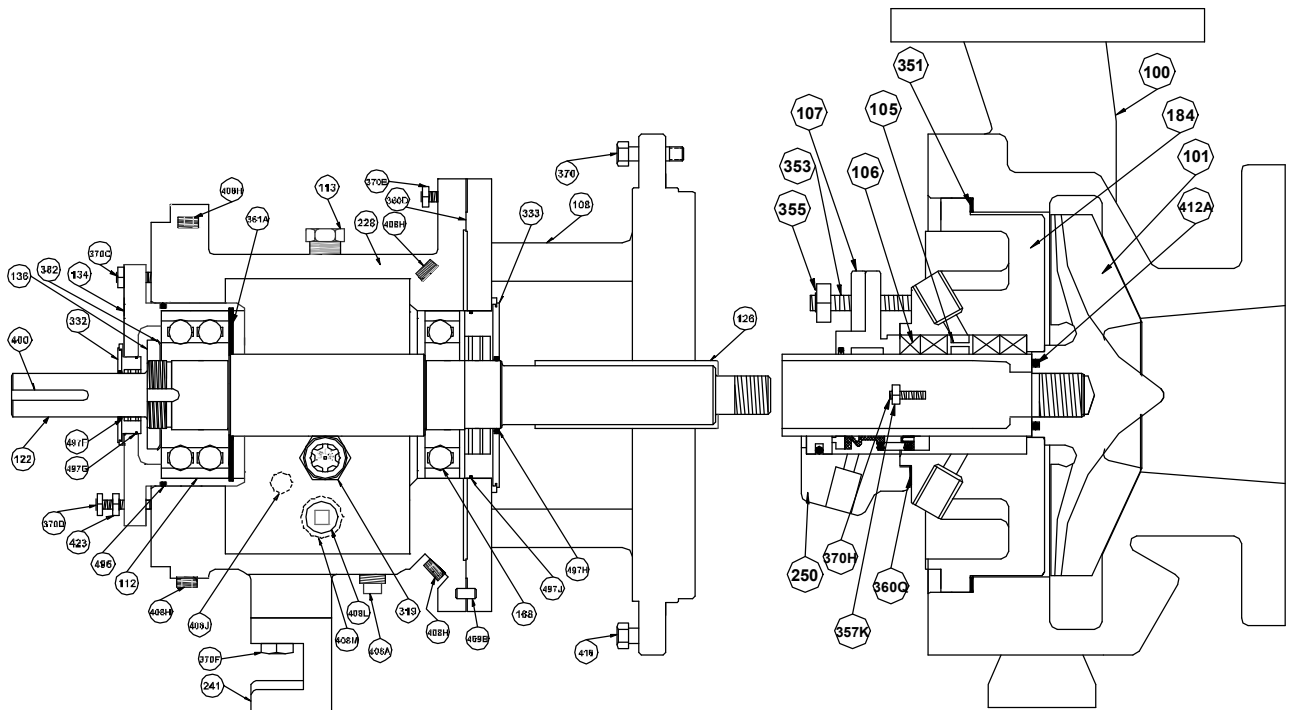


APPENDIX - VIII

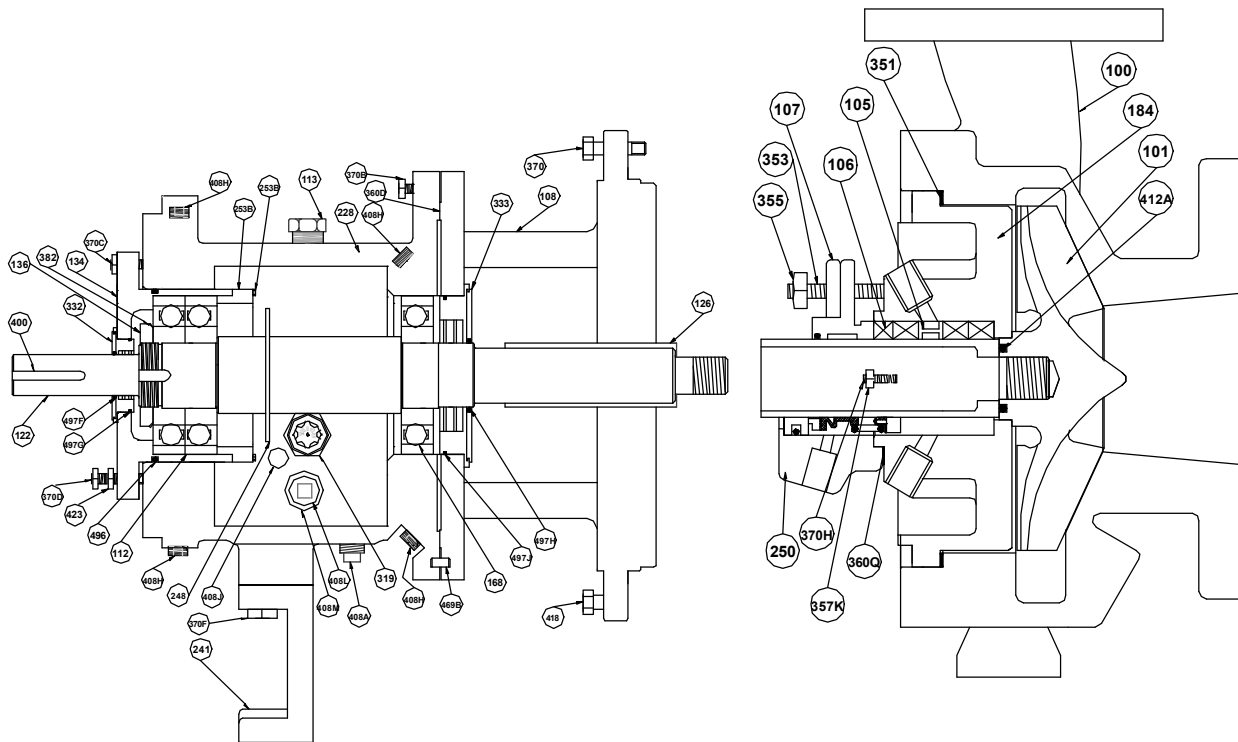
811S Group Pump Cross Sectional



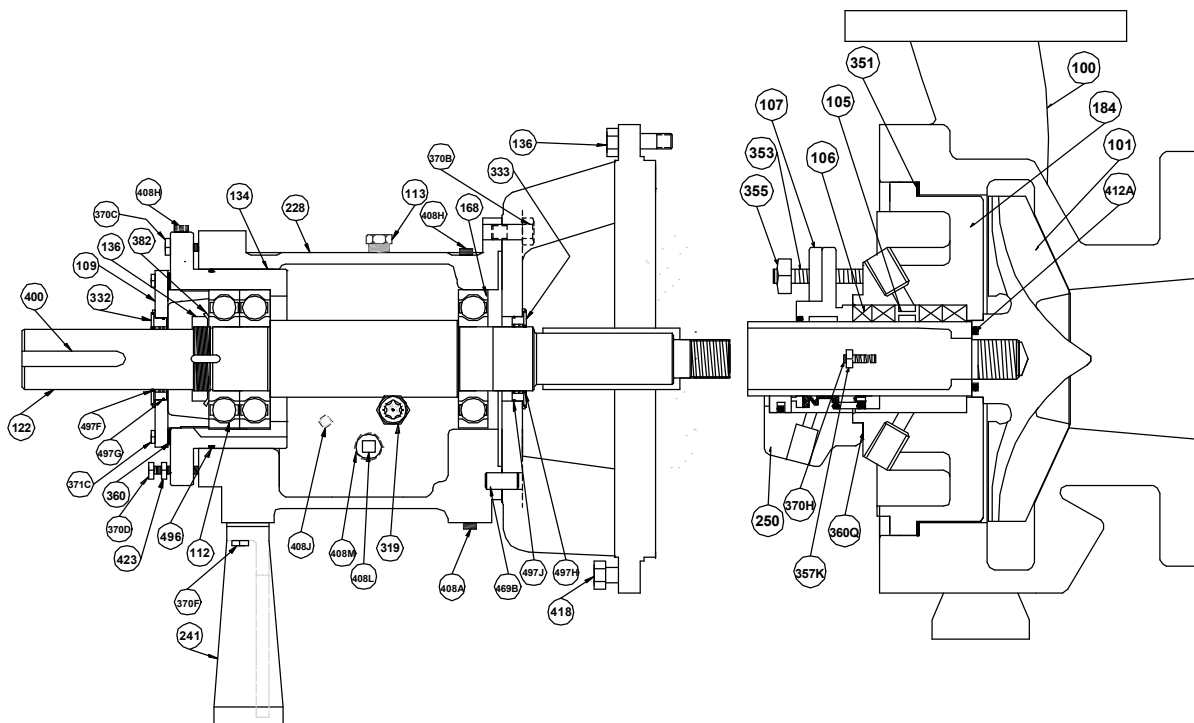
811M Group Pump Cross Sectional



811L Group Pump Cross Sectional



811XL / 811XL-17 Group Pump Cross Sectional



Parts & Material Composition

ITEM NO.	REQ'D PER PUMP	PART NAME	ALL DUCTILE IRON	ALL 316SS	ALL ALLOY 20	ALL CD4MCu	ALL MONEL	HAST-ELLOY B&C
100	1	Casing	DI	316SS	Alloy 20	CD4MCu	Monel	B&C
101	1	Impeller	DI	316SS	Alloy 20	CD4MCu	Monel	B&C
105	1	Lantern Ring	Glass Filled TFE					
106	1	Packing	SIL C-8201 Acid Rest.		TFE			
107	1	Packing Gland	316SS		Alloy 20		Monel	B&C
108	1	Frame Adapter	Ductile Iron					
112	1	Outboard (Thrust) Bearing	Double Row Angular Contact**					
122	1	Shaft - Less Sleeve (Optional)	316SS					
122	1	Shaft - With Sleeve	SAE4140				316SS	
126	1	Shaft Sleeve	316SS		Alloy 20		Monel	B&C
134	1	Bearing Housing	Cast Iron					
136	1	Lock Nut / Lock Washer	Steel					
168	1	Inboard (Radial) Bearing	Single Row Deep Groove					
184	1	Stuffing Box	DI	316SS	Alloy 20	CD4MCu	Monel	B&C
228	1	Frame	Cast Iron (Ductile for Small Frame)					
241	1	Frame Foot	Cast Iron					
250	1	Gland	316SS		Alloy 20			
319	1	Sight Oil Gauge	Cad. Plated					
332A	1	Labyrinth Oil Seal (Outboard)	Bronze (Optional Carbon Filled Teflon)					
333A	1	Labyrinth Oil Seal (Inboard)	Bronze (Optional Carbon Filled Teflon)					
351	1	Casing Gasket	Aramid Fiber with EPDM Rubber					
353	4	Gland Stud	316SS					
355	4	Gland Nut	304SS					
357K	2	Hex Nut	304SS					
358A	1	Casing Drain Plug (Optional)	Steel	316SS	Alloy 20	316SS	Monel	Hastelloy
360	1	"Gasket, Frame-to-Adapter"	Vellumoid					
360A	1	"Gasket, Bearing End Cover"	Vellumoid (811XL Only)					
370	3	Brg. Hsg.Hex Bolt	Steel					
418	3	Cas. Jack Screw	Steel					
469B	2	Dowel Pin	Steel					
496	1	Brg. Hsg. O-Ring	Buna Rubber					
496A	1	Impeller O-Ring	Glass Filled TFE					

** 811L Power End features Duplex Angular Contact

APPENDIX - IX

WARNING

Before assembling or disassembling the coupling guard, de-energize the motor, lock out the motor controller/starter, and place a caution tag at the starter indicating that it is disconnected. Before resuming normal pump operation, replace the coupling guard. Griswold Pump assumes no liability when this procedure is not followed..

ANSI B15.1 COUPLING GUARDS

ASSEMBLY PROCEDURES

Note:

If the end plate (pump end) was previously installed, make any necessary adjustments to the coupling and skip to Step 2.

1. On the 811S, 811M, and 811L, bolt the end plate (pump end) to the bearing frame. (Impeller adjustment will not be affected.)

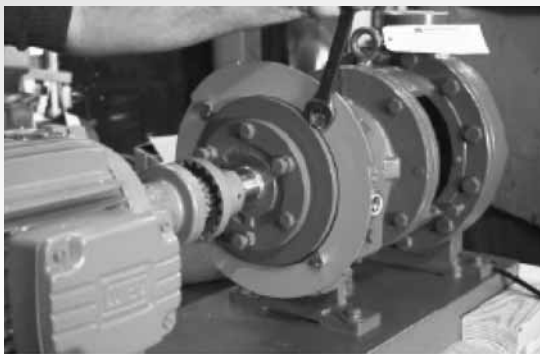


FIGURE A-2
COUPLING GUARD END PLATE

On the 811XL, bolt the end plate (pump end) to the pump bearing housing with the small slots on the end plate aligned to the impeller adjusting bolts and the large slots clearing the bearing housing tap bolts. Then attach the end plate to the bearing housing using the jam nuts on the impeller adjusting bolts as shown in *Figure A-2*. After attaching the end plate to the bearing housing, check and reset the impeller clearance as detailed in *APPENDIX. 1 - IMPELLER CLEARANCE SETTING*.

2. Slightly spread the bottom of coupling guard half (pump end) and place it over the pump end plate as shown in *Figure A-3*. The support slots in the guard half are located around the end plate.
3. After placing the coupling guard half around the end plate, secure it with a bolt, nut and two (2) washers through the round hole in the front end of the guard half as shown in *Figure A-3*. Tighten securely.

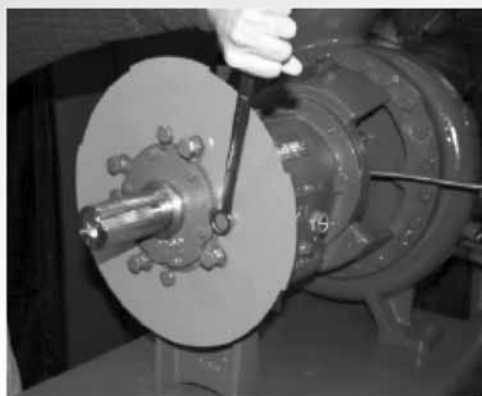


FIGURE A-2 811XL
COUPLING GUARD END PLATE



**FIGURE A-3
COUPLING GUARD BARREL**



**FIGURE A-4
COUPLING GUARD BARREL
DRIVER END**

4. Slightly spread the bottom of coupling guard half (driver end) and place it over the coupling guard half (pump end) so that the support slots in the coupling guard half (driver end) faces the driver as shown in *Figure A-3*.
5. Adjust the length of the coupling guard to completely cover the shafts and coupling as shown in *Figure A-5* by sliding the coupling guard half (driver end) toward the motor. After adjusting the length, secure the guard with a bolt, nut and two (2) washers through the slotted holes at the center of the guard and tighten. Check tightness on all of the nuts on the guard assembly.



**FIGURE A-5
COUPLING GUARD
ADJUSTING THE LENGTH**



Before assembling or disassembling the coupling guard, de-energize the motor, lock out the motor controller/start and place a caution tag at the starter indicating that it is disconnected.

Before resuming normal pump operation, replace the coupling guard. Griswold Pump assumes no liability when this procedure is not followed.

DISASSEMBLY PROCEDURES

It is necessary to remove the coupling guard for certain pump maintenance and adjustments, such as coupling alignment, impeller clearance adjustment and so forth. Replace the coupling guard after completing maintenance.

DO NOT resume normal pump operation while the coupling guard is removed.

Note:

Refer to the illustration for assembly beginning with Fig. A-5 and working in the reverse order.

1. Remove the nut, bolt and washers from the center-slotted hole on the coupling guard. Slide the motor end of the coupling guard half toward the pump. (See *Figure A-5*).
2. Remove the nut, bolt and washers from the driver end of the coupling guard half.
3. Slightly spread the bottom of the driver end coupling guard half and lift it off.
4. Remove the nut, bolt and washers from the pump end of the coupling guard half.
5. Slightly spread the bottom of the pump end coupling guard half and lift it off.
6. Remove the bolts from the bearing housing and remove the end plate. (See *Figure A-2*).

APPENDIX - X

Seal Guard

Seal guards (shown below) are available when all rotating shaft components must be covered. This option is required for all CE pump models.



When ordered, the pump will be shipped with the seal guard installed. The seal guard is supplied with captive fasteners to secure the guard in place.

Prior to startup, ensure that the guard has not been removed, damaged, or loosened during transportation, loading/unloading, installation, etc.

Never loosen or remove the seal guard during operation.

Before removing the seal guard for pump maintenance, de-energize the motor, lock out the motor controller/start and place a caution tag at the starter indicating that it is disconnected. Before resuming normal pump operation, replace the seal guard.

For maintenance, the guards can be removed by loosening the captive fasteners.



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